

c. Soil borings shall be converted to water table observation wells and well nests in accordance with the following schedule:

1) Three wells nests consisting of a water table observation well and a piezometer in the unconsolidated material.

2) One piezometer within the competent bedrock at one of the well nest locations.

d. Analyze each significant soil layer encountered during boring investigations for grain-size distribution and classify according to the unified soil classification system.

e. At least one laboratory permeability test shall be conducted for each significant soil layer above and below the water table. Single well response tests shall be performed on all on-site wells.

f. A summary of the groundwater monitoring data obtained under ss. NR 635.12 and 635.16, where applicable.

2. Summarize the results of the subsurface investigations utilizing a series of geologic sections which connect the soil borings performed. In each section show present topography, soil borings, soil classification and other properties, interpreted soil stratigraphy, bedrock, well construction permeability results and stabilized water level readings for each well.

3. Prepare a water table contour map based on stabilized water level readings. The topographic map shall be used as a base for this map.

4. A summary of all groundwater, gas, surface water and physical features monitoring previously performed for the facility, including all monitoring required under chs. NR 600 to 685.

5. A description of any plume of contamination that has entered the groundwater from any treatment, storage or disposal unit at the time the initial site report is submitted that:

a. Delineates the extent of the plume on the map required under subd. 1.a.; and

b. Identifies the concentration of each hazardous constituent in ch. NR 635 - Appendix I throughout the plume or identifies the maximum concentrations of each ch. NR 635 - Appendix I hazardous constituent in the plume.

(d) *Data analysis.* From the results of the field investigations, regional geotechnical information and land use information, analyze and make preliminary conclusions and recommendations on site development. Include a discussion of the potential for the site to meet the locational requirements in s. NR 660.06 and potential limitations on site development.

(e) *Preliminary liner assessment.* One or more potential alternatives for a primary liner meeting the requirements of s. NR 660.13 (10) (a) shall be identified.

(em) *Proposed testing, primary liner.* A description of the proposed testing program for the primary liner shall be submitted which outlines the proposed procedures for performing the tests required in s. NR 660.09 (1) (g) and the number of samples necessary to obtain representa-

tive results. All proposed testing shall meet or exceed the requirements of the national sanitation foundation standard 54 for flexible membrane liners. The definitions of terms or words in section 2 of the national sanitation foundation standard 54 for flexible membrane liners shall apply to terms or words used in this subdivision where a dictionary definition does not exist or is not applicable. The description of the proposed testing program shall include:

1. Liner compatibility including:
 - a. The effect of soil pH.
 - b. The effect of chemical contaminants within the soil.
 - c. Short-term testing to evaluate the ability of the liners to contain the waste and waste leachate.
 - d. Long-term testing including samples of the delivered liner and actual field constructed seams.
2. Susceptibility to attack by bacteria and fungi.
3. Physical suitability including:
 - a. Tear resistance.
 - b. Puncture resistance.
 - c. Creep resistance.
 - d. Elongation potential.
 - e. Membrane thickness.

Note: The publication containing these standards may be obtained from:

National Sanitation Foundation
P.O. Box 1468
Ann Arbor, Michigan 48106

The publication containing these standards is available for inspection at the offices of the department, the secretary of state and revisor of statutes.

(er) *Proposed testing, secondary liner.* A description of the proposed testing program for the secondary liner shall be submitted which outlines the proposed procedures for performing the tests required in s. NR 660.09 (1) (h) and describes the number of samples necessary to obtain representative results. The description of the proposed testing program shall include:

1. For short and long-term permeability testing, the:
 - a. Types of permeant;
 - b. Proposed pressure gradients;
 - c. Number of pore volumes to be passed through the samples;
 - d. Chemical analysis of the influent through time; and
 - e. Chemical analysis and volume measurements of effluent being discharged through time.

2. A description of the physical testing program of the samples before and after permeability testing to meet the requirements of s. NR 660.09 (1) (h) 2.

(f) *Appendix.* Show the site boundaries on all maps included in the appendix. In the appendix include:

1. All new data such as boring logs, soil tests, well construction data, water level measurements and test data and results.

2. A plat map of the area.

3. A USGS quadrangle of the area, updated with locations of applicable wells installed after preparation of the quadrangle.

4. A soil conservation service soil map and interpretation, if available.

5. References.

History: Cr. Register, February, 1991, No. 422, eff. 3-1-91; corrections in (2) (c) 5. b. and (e) made under s. 13.93 (2m) (b) 1. and 7., Stats., Register, May, 1992, No. 437.

NR 660.09 Feasibility report. (1) Unless specifically exempted in s. NR 660.04, no person may establish or construct a hazardous waste landfill or surface impoundment, expand an existing facility or be issued an initial operating license under s. NR 680.32 without first obtaining approval of a feasibility report describing the physical conditions of the proposed facility and subsequently obtaining approval of a plan of operation from the department. The purpose of the feasibility report is to determine whether the facility has potential for use as a hazardous waste landfill or surface impoundment and to identify any conditions which the applicant is required to include in the plan of operation. The feasibility report shall be submitted in accordance with s. 144.44, Stats., and ss. NR 680.05 and 680.06.

(a) All information specified in s. NR 660.08 (2) shall be submitted.

1. If an initial site report has been submitted, the applicant shall include all pertinent information contained in the feasibility report.

2. If an initial site report has been reviewed by the department, additional information addressing all department review comments shall be included.

(b) The applicant shall prepare an existing site condition topographic plan which shall contain a detailed topographic survey of the facility area and all area within a distance of 1500 feet of the facility. The minimum scale of this plan shall be one inch = 200 feet with a maximum 2-foot contour interval. The contour interval shall be sufficient to clearly show the pattern of surface water flow in the vicinity of and from each operating unit of the facility. All elevations shall be related to USGS data. More than one plan sheet shall be prepared to show the required information if one sheet is too detailed to be clear. The plan or plans shall clearly show:

1. 100-year floodplain area.

2. Surface waters, including intermittent streams.

3. Homes, buildings, man-made features and utility lines.

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4. Surrounding land uses, such as residential, commercial, agricultural and recreational.

5. Property boundaries, facility or waste management boundaries and fill areas, including any previous fill area.

6. Access control, such as fences and gates.

7. Water supply wells and any other wells, such as irrigation wells.

8. Well boring locations and observation well locations.

9. A wind rose, which show prevailing wind speed and direction.

10. Buildings, treatment, storage or disposal operations; or other structures such as recreation areas, runoff control systems, access and internal roads, storm, sanitary and process sewerage systems, loading and unloading areas and fire control facilities.

11. Barriers for drainage or flood control.

12. Location of operational units within the facility where hazardous waste is or will be treated, stored or disposed of, including equipment cleanup areas.

(c) Field and laboratory investigations shall be performed to further define site physical characteristics including soils, bedrock and groundwater. These investigations shall include:

1. Sufficient soil borings to adequately define the soil and bedrock conditions at the site. At a minimum, 5 soil borings for the first 5 acres and 3 borings for each additional 5 acres or portion thereof shall be performed. The borings shall be located in a grid pattern to provide at least one boring in each major geomorphic feature, such as ridges, lowlands and drainage swales. All borings shall extend at least 30 feet below the anticipated facility base grade or to bedrock, unless the depth to bedrock is 100 feet or more below the facility base grade.

2. Soil samples shall be collected utilizing standard undisturbed soil sampling techniques. Samples may not be composited for testing purposes. Soil samples shall be collected on a continuous basis from the ground surface to at least 30 feet below the anticipated base of the facility. After that point, soil samples shall be collected from each soil layer encountered and at maximum 5-foot intervals. All soil and bedrock samples shall be described and retained until the department issues a feasibility determination. Representative samples of all major soil units and bedrock formations shall be retained until the department issues an operating license for the facility.

3. Boring logs accurately recording soil and bedrock conditions encountered at the site shall be submitted for all borings. Each log shall include soil and rock descriptions, method of sampling, sample depth, date of boring, water level measurements and dates, and soil test data. All elevations shall be corrected to USGS data.

4. For each significant soil layer encountered, at least 3 soil samples shall be analyzed for grain size distribution, either mechanically or as appropriate to the soil type, and classified according to the unified soil classification system.

5. At least 3 laboratory permeability tests shall be conducted for each significant soil layer above and below the water table. Single well response tests shall be performed on all on-site wells.

6. Estimates and, when necessary, field and laboratory tests shall be provided for porosity, effective porosity, transmissivity, storage capacity, secondary permeability, diffusion coefficient and dispersion coefficients, cation exchange capacity, soil buffering capacity and any other physical or chemical soil characteristics that may be necessary to assess the environmental feasibility of the site.

7. Soil borings within the unconsolidated material shall be converted to water table observation wells and well nests in accordance with the following a schedule:

a. At least 5 water table observation wells and 3 well nests for the first 5 acres or portion thereof.

b. At least 3 water table observation wells and one well nest for each additional 5 acres or portion thereof.

8. Soil borings to the competent bedrock surface shall be converted to piezometers in accordance with the following schedule:

a. At least 3 piezometers for the first 5 acres or portion thereof.

b. At least one piezometer for each additional 10 acres or portion thereof.

9. Well construction information shall include the elevations of the ground surface, top and bottom elevation of well pipe, the bottom of the boring, and well seals; length of screened interval; diameter of boring; a description of well construction and backfill materials and boring logs as specified in subd. 3. Observation wells which may be used as monitoring wells shall meet the requirements specified in s. NR 635.12 (1) to (12) for monitoring wells shall be met.

10. Upon completion, each well shall be properly developed. At least 3 rounds of chemical testing for field conductivity, adjusted to 25° C, field pH, COD and TOC shall be performed to help determine if all the wells are properly developed. Additional development and chemical testing shall be performed as needed until all wells are chemically stabilized and produce representative samples of groundwater quality.

11. Once developed, all wells shall be pumped and successive water level measurements shall be made until stabilized readings are obtained.

12. Where public or private wells are present within one half mile of the proposed site, the groundwater aquifer shall be evaluated based on well logs, well construction reports and available pump test results, along with details on well location, ownership and well driller. The department may require the owner or operator to attempt to obtain stabilized water level readings from these wells.

13. The department may require the owner or operator to attempt to sample all public or private wells within one half mile of the proposed site and analyze for the parameters and characteristics specified in ch. NR 635.

(d) Data shall be presented as follows:

1. All raw data such as boring logs, well logs, well construction diagrams, soil tests, permeability tests and calculations, water quality and water level measurements shall be included in the report appendix.

2. A series of geologic cross-sections passing through all borings shall illustrate existing topography, soil borings, soil classification and other properties, interpreted soil stratigraphy, bedrock, well construction and stabilized water level readings for each well.

3. At least 2 water table contour maps representing yearly high and low water table conditions shall be constructed based on stabilized water level readings. The existing site conditions plan shall be used as a base for this map. Seasonal changes in groundwater levels shall be recorded by measuring water levels in all on-site wells at least monthly from the time the initial wells are installed.

4. Groundwater flow net sections shall be prepared to illustrate horizontal and vertical flow directions. This information shall be illustrated on geologic sections.

(e) The anticipated types, amounts and characteristics of the hazardous and solid waste to be disposed at the site shall be described and evaluated with respect to design, operation, and to impacts on the air, surface water and groundwater quality. Chemical and physical tests shall be done on representative waste samples and on representative or simulated leachate samples using approved procedures. All testing shall be documented.

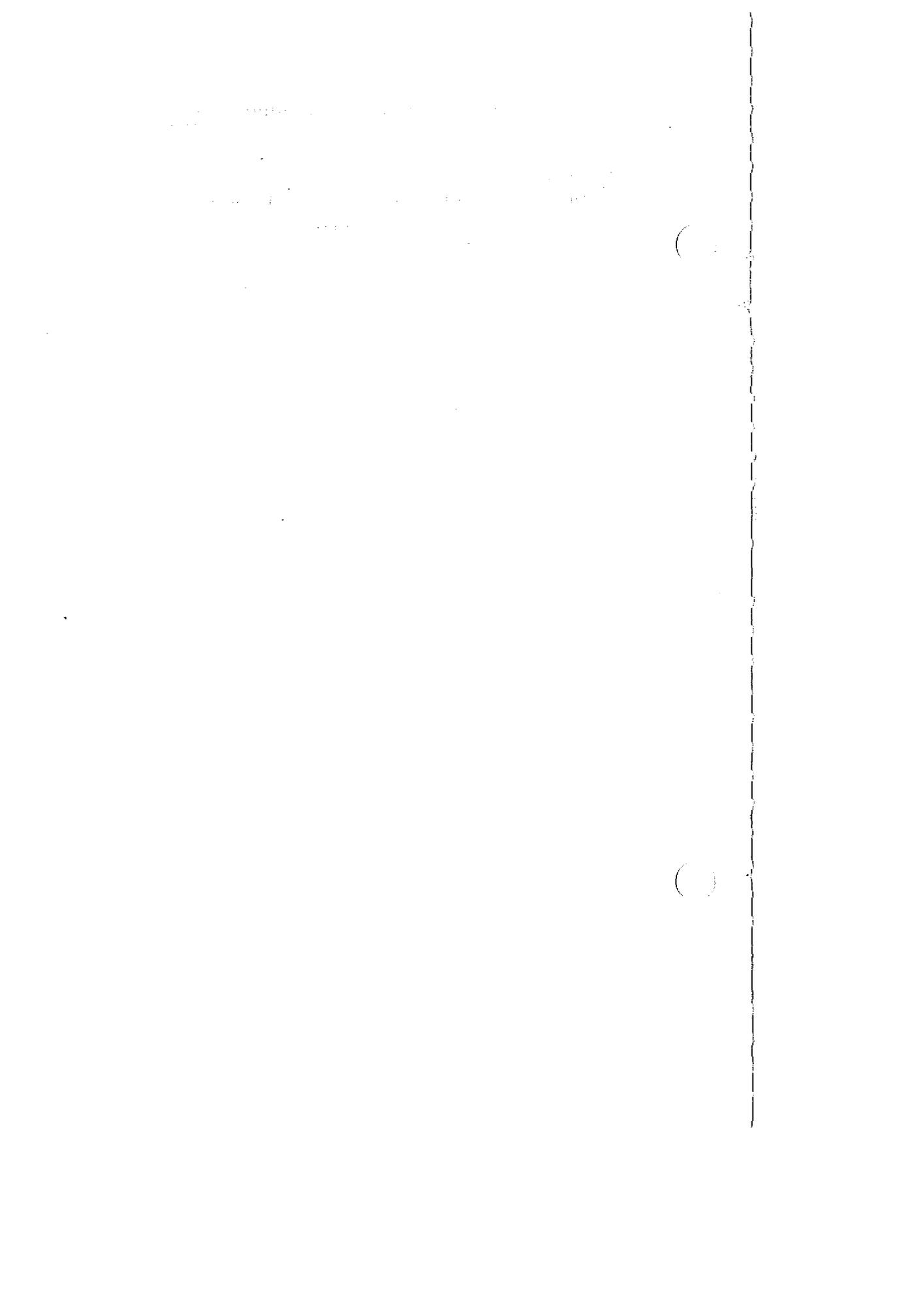
(f) A water balance shall be prepared for the periods of time before construction, during active operations and after site closure. Factors to be considered in preparation of the water balance are precipitation, infiltration, runoff, soil and waste moisture holding capacity, the physical and chemical characteristics of the waste, surface water and groundwater conditions, and proposed design concepts. The water balance analysis shall address leachate generation rates and the effect of the site on surface water and groundwater levels, quantity and quality for worst, average and best case conditions.

(g) The items set forth in subd. 1 to 11 shall be evaluated and discussed in accordance with procedures outlined in the national sanitation foundation standard 54 for flexible membrane liners or as otherwise approved in writing by the department to justify the type of primary liner being proposed. The definitions of terms or words in section 2 of the national sanitation foundation standard 54 for flexible membrane liners applies to terms or words used in this paragraph where a dictionary definition does not exist or is not applicable. The items which shall be evaluated and discussed include but are not limited to the following:

1. A complete description of the proposed liner material including:
 - a. Manufacturers name, address and telephone number.
 - b. Thermal properties.
 - c. Chemical resistance including the results of all waste compatibility studies.
 - d. Material formulation including additives such as:
 - 1) Antioxidants.

- 2) Antistatic agents.
- 3) Colorants.
- 4) Fillers such as extenders, carriers and reinforcing agents.

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(34) A surface impoundment that has been removed from service in accordance with the requirements of this section and that is not being repaired shall be closed in accordance with the provisions of s. NR 660.15 or 660.16, whichever is applicable.

(35) A surface impoundment shall be designed, constructed, maintained and operated to prevent overtopping resulting from normal or abnormal operations; overfilling; wind and wave action; rainfall; run-on; malfunctions of level controllers, alarms and other equipment; and human error.

(36) A surface impoundment shall have dikes that are designed, constructed and maintained with sufficient structural integrity to prevent massive failure of the dikes. In ensuring structural integrity it may not be presumed that the liner system will function without leakage during the active life of the unit.

History: Cr. Register, February, 1991, No. 422, eff. 3-1-91.

NR 660.14 Monitoring. (1) **GAS MONITORING.** The department may require the installation of gas monitoring devices and sampling and analysis programs for protection against potential detrimental effects of gas production and to monitor the effectiveness of gas venting systems. Sample collection and analysis techniques shall be in accordance with standard methods.

(2) **SURFACE WATER MONITORING.** The department may require monitoring of surface water runoff, leachate seeps, sump pump discharges, sedimentation ponds and other surface water discharges resulting from facility operation and of surface waters which may be affected by the discharges. Sampling times and parameters shall be as specified by the department on a case-by-case basis.

(3) **MONITORING OF PHYSICAL FEATURES.** The department may require monitoring of air quality, landfill settlement, berm stability, vegetation growth, drainage control structures or other aspects of site or facility operation. The requirement shall be based upon facility characteristics and design features.

(4) **OPERATIONS REPORT.** The department may request the owner or operator of any landfill or surface impoundment to submit an operations report to assess the effectiveness and environmental acceptability of site operations. The contents of the report may include a discussion and analysis of entrance and access roads, confinement of active area, analysis of gas and leachate and other monitoring, cover to waste ratios, surface water control and erosion control, revegetation, settlement, volume utilized, site users, leachate quantity and quality, slope stability, equipment performance and volume and type of waste accepted.

History: Cr. Register, February, 1991, No. 422, eff. 3-1-91.

NR 660.15 Closure of facilities without operating licenses. (1) In addition to the closure requirements in s. NR 685.05 any person who maintains or operates a hazardous waste landfill or surface impoundment, without an operating license under s. NR 680.32, or who permits use of property for a facility shall comply with the requirements of this section. Whenever a fill area or portion thereof reaches final grade or when the department determines that closure is required, the landfill or surface impoundment shall cease to accept waste. The fill area or portion thereof shall be closed

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in accordance with any plan approval issued by the department and the following requirements:

(a) Within 60 days after ceasing to accept waste, weather permitting, closure shall be accomplished as required in subds. 1 to 4. Placement of a final cover in accordance with all or a portion of the requirements of s. NR 660.16 (1) may be required if the department determines that an improved final cover system is necessary to prevent or abate the ground-water standards contained in ch. NR 140 from being attained or exceeded or to meet the requirements contained in s. NR 635.15 or 635.16 (14).

1. At final closure of the facility or upon closure of any unit or cell, the owner or operator shall cover the facility, unit or cell with a final cover designed and constructed to:

a. Provide long-term minimization of migration of liquids through the closed facility;

b. Function with minimum maintenance;

c. Promote drainage and minimize erosion or abrasion of the cover;

d. Accommodate settling and subsidence so that the cover's integrity is maintained; and

e. Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

2. The entire unit or area previously used for disposal purposes shall be covered with at least 60 cm (2 feet) of compacted clay, sloped adequately to allow surface water runoff. Slopes shall be no less than 2% and no steeper than 33%. This 60 cm (2-foot) clay layer shall meet the following specifications:

a. Have a saturated undistributed hydraulic conductivity of not more than 1×10^{-7} cm/sec.

b. Be compacted to 90% modified proctor density, as determined by the test method specified in ASTM standard D-1557-78.

c. Be constructed in lifts which do not exceed 20 cm (8 inches) after compaction.

Note: The publications containing this standard may be obtained from:

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

The publication containing this standard is available for inspection at the offices of the department, the secretary of state and the revisor of statutes.

3. Surface water shall be diverted to limit the potential for erosion and sedimentation. Wherever possible, surface water shall be diverted around previously filled areas. Where it is necessary to divert drainage over previously filled areas, drainage shall be conveyed by lined drainage swales having a minimum of 60 cm (2 feet) of clay.

4. The finished surface of the filled area shall be covered with a minimum of 15 cm (6 inches) of topsoil.